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PALYNOLOGICAL INVESTIGATIONS INTO SEDIMENTS OF THE LOWER PALAEOGENE PERIOD IN BULGARIA

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Abstract

We have performed spore-pollen investigations into the sediments of the lower Palaeogene Period in Pleven. The sporomorphous assemblages are extremely rich in Hystrichosphaeridae remains, and a part of the samples examined in sporomorphs, as well. The Pteridophyta are represented by 10, the Gymnospermatophyta by 2, the Angiospermatophyta by 39 microremains. At the marl-level in Bozurica the pine-pollen grains with bladders predominate, and, apart from these, the quantity of the forms of Castanea type is considerable. In the spore-pollen assemblage of the habitat of Komarevo the dominance of the pollen grains referring to the genus Castanea is prominent. The qualitative composition of the samples investigated points to the lower Eocene Period (lower Sparnacian Stage).

Introduction

The sporomorphs of the lower Tertiary sediments in Bulgaria were treated of by ČERNJAVSKA (1966, 1967a, b, 1969, 1970a, b, 1973) and ČERNJAVSKA and PETKOVA (1968). Their investigations included the upper Eocene, resp. the Oligocene sediments. In connection with the upper Eocene vegetation it was established that although it was very similar to the German upper Eocene, nevertheless there could be ascertained some differences due to the territorial origin. In connection with the Eocene spore-pollen assemblages in Hungary it also arose that they differ from the West-European sediments, primarily from the types well known from the classical sediments of the Parisian basin in more, not unimportant characteristics. This is particularly obvious first of all at the pollen of angiosperms, and within this at the pollen grains of short axis. Owing to this, there was necessitated the description of several new form-species (KEDVES 1974). These results are raising the idea that the extremely definite regional differences which were ascertained in the angiospermous vegetation of the upper Cretaceous Period manifest themselves, though not in so high degree, even in the lower Tertiary Period. Apart from this, at any rate, it is possible, too, that the differences observed in the lower Tertiary may already be attributed to other causes than in the upper Cretaceous Period. In order to bring this problem forward, my interest turned to the sporomorphs of the sediments in the South-European lower Tertiary. Within this, from the point of view of the phylogeny of the angiosperms, one of the crucial periods, the Palaeocene one seemed to me very considerable. To my request, my colleague, S. ČERNJAVSKA, was good enough to place at my disposal several samples for investigation. The results of these are summed up in this work.

Materials and Methods

The samples investigated have been collected by Em. Belmoustakov. These are as follows: Pleven-1, Bozurica, marl level; Pleven-2, Bozurica; Pleven-3, Petrnica; Pleven-4, Komarevo — these are determined as originating from the Palaeocene Epoch. From the habitat at Lukovit the Lutetian Stage is represented by one sample. The exposure of sporomorphs took place with HCl, for precipitating $ZnCl_2$ was used, then a treatment with HF followed. The clearing of precipitation was carried out with borated hydrochloric acid. We permformed the investigation of sporomorphs with light-microscopic method, taking into consideration not only the qualitative but also the quantitative data of every sample. From among the microphotographs, there are only published those made of a new type which could not be determined nearer or of the form-species that differ from the typical forms to a certain extent.

Results

1. In the course of the investigations, we succeeded in demonstrating the following sporomorphous taxons:

Fgen.: *Leiotriletes* (NAUMOVA 1937) R. POT. et KR. 1954. *L. adriennis* (R. POT. et GELL. 1933) W. KR. 1959, Schizaeaceae, cf. *Lygodium, L. dorogensis* (KDS. 1960) KDS. 1961, Schizaeaceae, cf. *Lygodium.*

Fgen.: *Concavisporites* PF. 1953. C. *(Concavisporites) hungaricus* KDS. 1973, Gleicheniaceae.

Fgen.: *Trilites* COOKSON 1947 ex COUPER 1953. *T. paravallatus* W. KR. 1959, Schizaeaceae, *Lygodium* v. Dicksoniaceae, *Cibotium.*

Fgen.: *Ischyosporites* BALME 1957. *I. asolidus* (W. KR. 1959) W. KR. 1967, Schizaeaceae.

Fgen.: *Foveasporis* W. KR. 1959. F. cf. *linearis* W. KR. 1959 (Plate 1, 2). The specimens occurring in our material are somewhat smaller than the typical forms described from the middle Eocene in Geiseltal. Further on, the densennes of the foveae of the exosporium is also somewhat smaller.

Fgen.: *Polypodiaceoisporites* R. POT. 1956. *P. brevisculptatus* KDS. 1973, Pteridaceae, *P. verruspeciosus* W. KR. 1959, Pteridaceae, P. fsp. Pteridaceae (Plate 3, 4).

Fgen.: *Laevigatosporites* IBR. 1933. *L. haardti* (R. POT. et VEN. 1934) TH. et PF. 1953 subfsp. *hardtioides* W. KR. 1967, Polypodiaceae.

The recycled spores from the lower Cretaceous Period came to light from the *Appendicisporites* fgen. (Plate 5, 6).

Fgen.: *Pityosporites* SEWARD 1914. *P. labdacus* (R. POT. 1931b) TH. et PF. 1953 subfsp. *labdacus*, Abietaceae, *Pinus*, *P. microalatus* (R. POT. 1931b) TH. et PF. 1953, Abietaceae, *Pinus.*

Fgen.: *Trudopollis* PF. 1953. T. $fsp._1$, (Plate 7, 8). This type is also known from the Thanetian of Menat (KEDVES 1967, Pl. I, 12, 13), T. $fsp._2$ (Plate 9, 10).

Fgen.: *Interporopollenites* WEYL. et KRIEG. 1953. I. fsp. (Plate, 11, 12). This fgen. is represented by a specimen in a bad enough state of preservation.

Fgen.: *Interpollis* W. KR. 1961. *I. supplingensis* (PF. 1953) W. KR. 1961, *I. microsupplingensis* W. KR. 1961, *I. velum* W. KR. 1961.

Fgen.: *Nudopollis* PF. 1953. *N. minutus* ZAKL. 1963.

Fgen.: *Plicapollis* PF. 1953. *P. pseudoexcelsus* (W. KR. 1958) W. KR. 1961 subfsp. *turgidus* PF. 1953, Myricaceae.

Fgen.: *Basopollis* PF. 1953. B. fsp. (Plate, 13, 14).

Fgen.: *Triatriopollenites* Pf. 1953. T. cf. *podagrarius* (Gladkova 1965) Kds. 1974, Myricaceae, *T. sauerae* (Gladkova 1965) Kds. 1974, Myricaceae, *T. aroboratus* Pf. 1953, Myricaceae.

Fgen.: *Plicatopollis* W. Kr. 1962. *P. lunatus* Kds. 1974, Juglandaceae.

Fgen.: *Platycaryapollenites* E. Nagy 1969. P. $fsp._{1-2}$, Juglandaceae, *Platycarya* (Plate 15—18).

The detailed taxonomical elaboration of the Palaeogene types of the form-genus requires still further work.

Fgen.: *Triporopollenites* Pf. et Th. 1953. *T. balinkaense* Kds. 1974. subfsp. *balinkaense*, cf. Ulmaceae, *T. undulatus* Pf. 1953, Ulmaceae, *T. pflugi* Kds. 1974, Juglandaceae v. Ulmaceae, *T. spackmanii* (Traverse 1955) Kds. 1970, Corylaceae, *T. robustus* Pf. 1953. subfsp. *robustus*, cf. Betulaceae, *T. nointelensis* Kds. 1970, Corylaceae, *T. urkutensis* Kds. 1974, Juglandaceae v. Betulaceae, *T. constans* Takahashi 1961, Corylaceae.

Fgen.: *Subtriporopollenites* Pf. et Th. 1953. *S. urkutensis* Kds. 1974, Juglandaceae cf. *Carya, S. sympathicus* (Botscharnikova 1960) Kds. 1970, Juglandaceae, *S. constans* Pf. 1953 subfsp. *constans* Juglandaceae.

Fgen.: *Alnipollenites* R. Pot. 1934. *A. verus* (R. Pot. 1931a) R. Pot. 1934 f. *hoellingi* R. Pot. 1931b, Betulaceae, *Alnus*.

Fgen.: *Pentapollenites* W. Kr. 1962. *P. laevigatus* W. Kr. 1962 subfsp. *laevigatus* Elaeagnaceae v. Simarubaceae.

Fgen.: *Monocolpopollenites* Th. et Pf. 1953. *M. tranquillus* (R. Pot. 1934) Th. et Pf. 1953 subfsp. *tranquillus*, Palmae.

Fgen.: *Cupuliferoidaepollenites* R. Pot. 1960. *C. quisqualis* (R. Pot. 1934) R. Pot. 1960, Fagaceae v. Leguminosae, Cf. *C. liblarensis* (Thoms. in Pot., Thoms. et Thierg. 1950) R. Pot. 1960, Fagaceae v. Leguminosae.

Fgen.: *Cupuliferoipollenites* R. Pot. 1960 non 1951. *C. pusillus* (R. Pot. 1934) R. Pot. 1960, Fagaceae, cf. *Castanea, C. oviformis* (R. Pot. 1931a) R. Pot. 1960, Fagaceae, *Castanea*.

Fgen.: *Cyrillaceaepollenites* (Mürriger et Pflug 1951) R. Pot. 1960. *C. barghoorniacus* (Traverse 1955) R. Pot. 1960, Cyrillaceae, Clethraceae v. Theaceae.

Fgen.: *Pleurospermaepollenites* Kulkova 1973. P. fsp. ? Umbelliferae (Plate 19, 20).

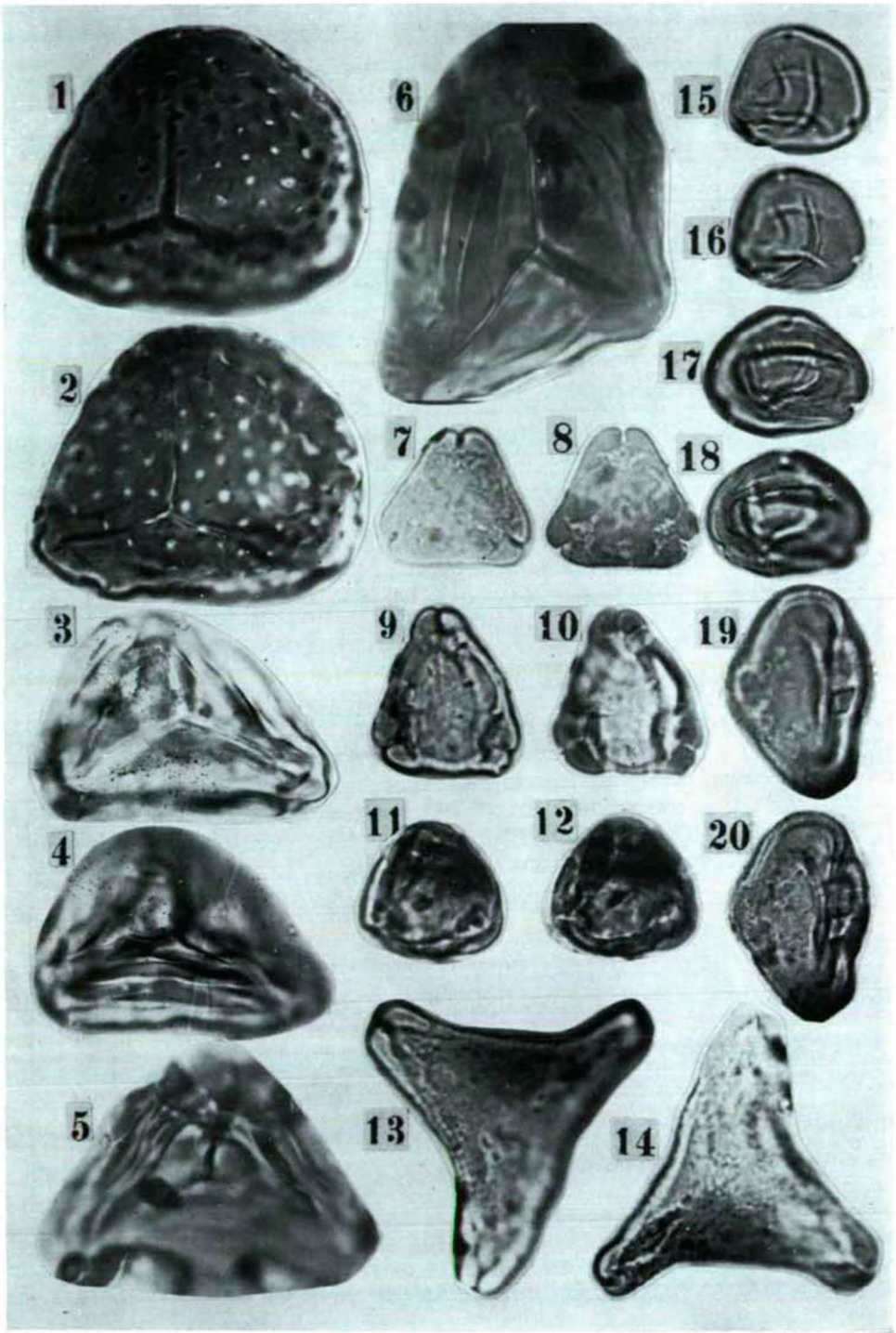
Fgen.: *Nyssapollenites* Thiergart 1937. *N. kruschi* (R. Pot. 1934) Simoncsics 1969 subfsp. *analepticus* (R. Pot. 1934) Simoncsics 1969, Nyssaceae.

Fgen.: *Ilexpollenites* (Thiergart 1937) R. Pot. 1960. *I. margaritatus* (R. Pot. 1931a) Thg. 1937 f. *medius* Pf. et Th. 1953, Aquifoliaceae. *Foveatricolporites* Pierce 1961. *F. gruas-cavagnettoae* Kds. 1977, cf. Rhamnaceae.

The spores and pollen grains refer to the following phylogenetical taxa:

Pteridophyta
Pteropsida (Schizaeaceae, cf. *Lygodium*, Dicksoniaceae, *Cibotium*, Gleicheniaceae, Pteridaceae, Polypodiaceae).
Gymnospermatophyta
Coniferopsida (Abietaceae, *Pinus*).
Angiospermatophyta
Dicotyledonopsida (Fabales, Elaeagnaceae, Nyssaceae, Simurubaceae, Aquifoliaceae; *Ilex*, cf. Rhamnaceae, Cyrillaceae, Clethraceae, ? Umbelliferae, Theaceae,

Plate 1



Ulmaceae, Betulaceae; *Alnus*, Corylaceae, Fagaceae; cf. *Castanea*, Juglandaceae, cf. *Carya*, Myricaceae.
Monocotyledonopsida (Palmae).

The quantitative data led to the following results:
Pleven

1. Bozurica (marl-level). It is comparatively poor in sporomorphs. The pollen of the pine with bladders and Fagaceae is relatively high. The sample contains a great number of Hystrichosphaeridae showing the saltwater environment.

2. Bozurica (?marl-level, Pleven—2). It is very rich in microfossils. Here similarly the pine with bladders and the Fagaceae pollen grains occur in a considerable amount. The number of Hystrichosphaeridae remains is extremely high.

3. Petrnica. Few sporomorphs with comparatively many Hystrichosphaeridae.

4. Komarevo — it is rich in micro-remains, the Fagaceae pollen grains predominate. There are similarly plenty of Hystrichosphaeridae. Lukovit (middle Eocene).
It does not contain quantitatively appreciable sporomorphs.

Discussion

The samples investigated on the basis of the demonstrated sporomorph-taxa cannot be considered as rich. None the less, on the basis of the high specimen number, certain conclusions may be drawn:

1. Stratigraphic conclusion

In the Lower Tertiary Period, as well, the angiospermous pollen grains have particular importance in respect of determining the geological age. The presence of Normapolles is, at any rate, referring to the older Tertiary. Thus the *Trudopollis* and *Interporopollenites* genera occur down to the lower Eocene but their main occurrence is the upper Cretaceous Period. The types of *Interpollis, Nudopollis, Plicapollis* (pseudoexcelsus), and *Basopollis* refer to the lower Eocene. From among the *Postnormapolles*, observed from the lower Eocene in Hungary, several common form-species occurred out of the *Triporopollenites* and *Subtriporopollenites*. It is essential that the typical pollen grains of the Palaeocene Epoch — *Stephanoporopollenites hexaradiatus* — are absent. The rather important types accompanying these pollen grains are similarly missing — like *Vacuopollis concavus, Nudopollis terminalis,*

◂ Plate 1

1,2. — *Foveasporis* cf. *linearis* W. Kr. 1959, Pleven 4/26; 17.7/113.2.
3,4. — *Polypodiaceoisporites* fsp., Pteridaceae, Pleven 4/9; 17.8/109.8.
5. — *Appendicisporites* fsp.$_1$, Pleven 2/26; 15.9/104.5.
6. — *Appendicisporites* fsp.$_2$, Pleven 2/27; 9.1/109.5.
7,8. — *Trudopollis* fsp.$_1$, Pleven 4/33; 7,2/106,2.
9,10. — *Trudopollis* fsp.$_2$, Pleven 4/27; 10.7/103.6.
11,12. — *Interporopollenites* fsp., Pleven 4/31; 15.0/108.3.
13,14. — *Basopollis* fsp., Pleven 4/30; 31.3/106.4.
15,16. — *Platycaryapollenites* fsp.$_1$, Juglandaceae, *Platycarya*, Pleven 4/7; 19.6/114.3.
17,18. — *Platycaryapollenites* fsp.$_2$, Juglandaceae, *Platycarya*, Pleven 4/20; 15.1/112.8.
19,20. — *Pleurospermaepollenites* fsp., ?Umbelliferae, Pleven 4/22; 14.8/106.7.
N: ×1000

N. endangulatus. The geological age of the samples investigated is therefore to be fixed on the lower Eocene. Taking into consideration the main types of the Paris Basin, we have reckon primarily with the lower Sparnacian Stage, owing to the older *Normapolles* pollen grains. On the other hand, one part of the older *Postnormapolles* accompanying these are missing. It is a difference too, that the ancient Myricaceae *(Plicapollis)* and Juglandaceae *(Platycaryapollenites, Plicatopollis)* are represented but in the slightest degree in the assemblages. Because of this and of the connection with the lower Eocene in Hungary, we must come to the result Cernjavska's establishment (1967a, 1970a) concerning the upper Eocene holds also true in respect of the lower Eocene. According to this, the Eocene vegetation in Bulgaria differentiates in its details from the Central — and West-European ones. It is to be mentioned as an interesting characteristic that the pollen grain of the *Alnus* genus occurred. This appears namely mainly in the upper Eocene in considerable quantities and is represented here only in the upper Oligocene.

2. Palaeobotanical conclusions

The representants of Pteridophyta are, by far the greatest number, of tropical character. It is interesting, although a far-reaching conclusion cannot be drawn from it, that the spores of the *Anemia* genus have not occurred in our material. Two types of the Abietaceae *Pinus* genus correspond to the general character of the lower Eocene floras but the comparatively high amount rather begins in the upper Eocene. The lack of the pollen grains of Taxodiaceae-Cupressaceae is interesting and unaccustomed. A considerable part of Dicotyledonopsida are represented by the amentiferous plants. On the basis of richness in form and number, these are most important. The great number of the pollen grains of *Castanea* type refers to a semiterrestrial bog. Another bog assemblage cannot be concluded from these. In higher areas *Pinus* forests may have been. In this case, however, we have, to refer to that the pollen production of pines is high and that they are transported far. Their quantitative data are, therefore, to be observed with criticism.

It is uncommon, as well, as compared with the lower Eocene floras, that the Myricaceae bog could not be demonstrated. It is similarly remarkable that the occurrence of the pollen grains of Palmae is extremely restrained.

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